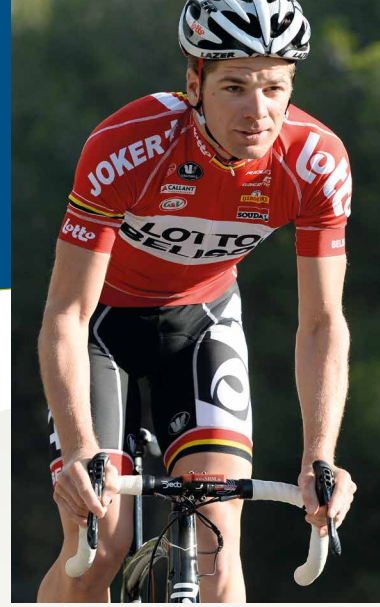
Faculty of Physical Education and Physiotherapy



We cordially invite you to the public defence of THE DOCTORAL DISSERTATION OF:

KEVIN DE PAUW

which will take place on
Friday, February 21 at 17:00
in the promotion Hall D.2.01 'Alois Gerlo'
located on the campus of Etterbeek

POST-EXERCISE RECOVERY: IMPACT ON CYCLING PERFORMANCE AND BRAIN FUNCTIONING. CYCLING, RECOVERY AND THE BRAIN

Promotors: Prof. dr. R. Meeusen
Prof. dr. B. Roelands

Prof. dr. E. Kerckhofs
Dean of the Faculty of Physical Education and Physiotherapy

Please confirm your presence before February 10 to kevin.de.pauw@vub.ac.be

How to reach the Vrije Universiteit Brussel http://www.vub.ac.be/infoover/campussen/index.htm

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Vrije Universiteit Brussel

Exam commission:

Prof. dr. Jean-Pierre Baeyens - Chairman
Department of Biomechanics and Biometry (Vrije Universiteit Brussel)

Dr. Shona Halson
Australian Institute of Sport (Canberra, Australia)

Prof. dr. Maria Francesca Piacentini
Department of Movement, Human and Health Sciences (Foro Italico, Rome, Italy)
Department of Human Physiology (Vrije Universiteit Brussel)

Prof. dr. Jos De Koning
Research Institute MOVE (VU University Amsterdam, The Netherlands)
Department of Exercise and Sport Science, University of Wisconsin La Crosse (Wisconsin, United States of America)

Prof. dr. Peter Clarys
Department of Biomechanics and Biometry (Vrije Universiteit Brussel)

Prof. dr. Evert Zinzen
Department of Movement Education and Sports Training (Vrije Universiteit Brussel)

Promotors:

Prof. dr. Romain Meeusen - promotor
Department of Human Physiology (Vrije Universiteit Brussel)

Prof. dr. Bart Roelands - promotor
Department of Human Physiology (Vrije Universiteit Brussel) – Fund for Scientific Research Flanders (FWO)

Presentation of the dissertation

Accelerating post-exercise recovery allows greater training loads, and it will positively affect exercise performance. The recovery process after exercise normalizes physiological functions, influences the mental preparedness and other higher brain functions such as cognition, attention and motivation. These are important for subsequent exercise performance. Possible ways to examine the effect of different recovery interventions on higher brain functioning is to determine the electrocortical activity (EEG) and molecular factors originating from within the brain.

Because of the need to consistently define the subject group in sport science research, the first aim of this thesis was to formulate guidelines on pre-experimental testing, the terminology and the classification of subject groups. Secondly, the main part of this thesis focused on the effect of different post-exercise recovery interventions on subsequent time-trial (TT) performance and physiological parameters in different environmental conditions. Additionally, the effect of exhaustive cycling and recovery in the heat on brain functioning was investigated.

An adequate recovery intervention between training sessions and races can result in small, but meaningful performance differences. Determining the impact of different recovery strategies on subsequent exercise performance is consequently of great clinical relevance. Experiments were conducted in a thermo-neutral (20°C) and hot environment (30°C). The first experimental trial was conducted in 20°C and consisted of two equal cycling bouts. Each cycling session included a 1h intensive cycling bout (30 min constant load trial and 30 min TT) interspersed by a 20 minute recovery intervention and 100 minute rest period. Immediately after the first cycling bout, passive rest (PR) with or without upper leg cooling (0°C and 10°C) or active recovery (AR; cycling at 80W) with or without upper leg cooling (0°C) were applied. It is well known that AR accelerates the blood lactate removal; however it was observed that the AR combined with upper leg cooling removed blood lactate even faster than AR alone. Small meaningful differences in TT performance were noticed. Active recovery slightly enhanced TT performance and the percentage difference in TT performance was more than 2% compared to the other recovery interventions.

Since cycling races often take place in warm environmental conditions, the second experiment was performed in the heat (30°C). This experimental trial consisted of two exercise tasks separated by 1h. The first was a 90 minute exhaustive cycling bout and the second comprised a 12 minute simulated TT. Immediately after the first cycling bout, 15 minutes of PR, AR or cold water immersion (CWI) were applied, followed by a rest period of 45 minutes. During CWI subjects were head-out immersed in water set at 15°C. This recovery method rapidly decreased the thermal strain, skin and body temperatures. Active recovery and CWI showed a trend towards faster blood lactate removal compared to PR. After CWI athletes were able to maintain a high power output throughout the TT, whereas AR and PR resulted in a significant progressive decrease of the power output.

In the last part of this PhD, the effects of exercise and recovery on brain functioning was investigated. For this purpose, EEG and the neurotrophin serum brain-derived neurotrophic factor (BDNF) were measured during the recovery experiment in the heat. In normal conditions exercise increases information processing within the brain. However, in the heat exhaustive cycling decreased electrocortical activity across the majority of the brain areas. This finding outlines decreased arousal levels and reduced central drive. This might be attributed to a direct effect of brain temperature and an indirect effect of altered information trafficking from the periphery. Another explanation might be the influence of high exercise intensity in the preferred sport on a higher sense of well-being, and/or positive emotions. Post-exercise AR and PR in the heat showed no significant electrocortical alterations, whereas CWI increased brain activity at the posterior margin of the insular cortex and the supramarginal gyrus, brain regions involved in the integration of somatosensory information processing. Post-exercise CWI also restored exercise-induced altered relative brain oscillations and serum BDNF to pre-exercise levels.

The novel findings of this thesis:

- In a thermo-neutral environment post-exercise AR resulted in small, but meaningful differences in subsequent time-trial performances compared to PR.
- Post-exercise CWI normalizes physiological parameters, activates brain areas responsible for somatosensory information processing, and restores exercise-induced altered brain oscillations and serum BDNF. These adaptations to CWI are responsible for the beneficial effect of post-exercise CWI on the pacing strategy during subsequent TT performance.

Curriculum Vitae

Kevin De Pauw graduated in July 2005 from the Vrije Universiteit Brussel as Master in Physical Education. His master thesis entitled 'Validation of the Oxycon Mobile' was conducted at the department of Human Physiology with Prof. Dr. Romain Meeusen as promoter. Since May 2006 Kevin is employed at the department of Human Physiology and he started his PhD project in February 2010. The research outcomes of the Lotto Sports Science Chair are 5 articles as first author (4 published and 1 under review) and 2 as co-author in scientific journals with an international referee system, and 5 chapters in international scientific books as co-author.